

What is claimed is:

1. A coated substrate comprising:
 - a) an organic underlayer composition coating layer on a substrate, the
5 underlayer composition comprising a component that comprises aromatic and/or alicyclic groups and a component that comprises one or more chromophore groups;
 - b) over the underlayer composition coating layer, a photoresist composition coating layer for imaging at less than 200 nm, the photoresist comprising a photoactive component and an Si-containing component.
- 10 2. The coated substrate of claim 1 wherein the underlayer composition comprises an integral component that comprises both i) aromatic and/or alicyclic groups and ii) chromophore groups.
- 15 3. The coated substrate of claim 1 wherein the underlayer composition comprises a first component that comprises aromatic and/or alicyclic groups and a second component distinct from the first component that comprises chromophore groups.
- 20 4. The coated substrate of any one of claims 1 through 3 wherein the chromophore groups comprise anthracene groups.
- 25 5. The coated substrate of any one of claims 1 through 4 wherein the underlayer composition component that comprises aromatic and/or alicyclic groups comprises optionally substituted phenyl groups, optionally substituted naphthyl groups, optionally substituted adamantyl groups, optionally substituted norbornyl groups, or optionally substituted isobornyl groups.
- 30 6. The coated substrate of any one of claims 1 through 5 wherein the underlayer composition comprises a mixture of at least two distinct resins.

7. The coated substrate of claim 6 wherein one resin of the underlayer composition comprises aromatic and/or alicyclic groups and a second resin of the underlayer composition comprises one or more chromophore groups.

5 8. The coated substrate of any one of claims 1 through 7 wherein the underlayer composition comprises i) a first resin that comprises units that comprises phenyl groups and ii) a second resin that comprises units that comprise anthracene groups.

10 9. The coated substrate of any one of claims 1 through 7 wherein the underlayer composition comprises a phenolic resin.

15 10. The coated substrate of any one of claims 1 through 7 wherein the underlayer composition comprises a novolak or poly(vinylphenol) resin.

 11. The coated substrate of any one of claims 1 through 10 wherein the underlayer composition comprises an acrylate resin.

20 12. The coated substrate of any one of claims 1 through 11 wherein the underlayer composition comprises an acrylate resin that comprises anthracene moieties.

 13. The coated substrate of any one of claims 1 through 12 wherein the underlayer composition comprises an acid or acid generator compound.

25 14. The coated substrate of any one of claims 1 through 13 wherein the underlayer composition comprises a thermal acid generator compound.

 15. The coated substrate of any one of claims 1 through 14 wherein the underlayer composition is not photoimageable.

30 16. The coated substrate of any one of claims 1 through 15 wherein the underlayer composition comprises a crosslinker component.

17. The coated substrate of any one of claims 1 through 16 wherein the underlayer composition is crosslinked.

5 18. The coated substrate of any one of claims 1 through 17 wherein a photoresist composition comprises a resin with Si groups.

19. The coated substrate of any one of claims 1 through 18 wherein a photoresist composition resin comprises alicyclic groups.

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20. The coated substrate of any one of claims 1 through 19 wherein a photoresist composition resin comprises photoacid-labile groups.

21. The coated substrate of any one of claims 1 through 20 wherein the
15 substrate is a microelectronic wafer substrate.

22. A method for forming a photoresist relief image comprising:

- 20 a) applying an organic underlayer composition coating layer on a substrate, the underlayer composition comprising a component that comprises aromatic and/or alicyclic groups and a component that comprises one or more chromophore groups;
- b) applying a photoresist composition coating layer over the underlayer composition, the photoresist composition comprising a photoactive component and an Si-containing component;
- 25 c) exposing the photoresist composition coating layer to radiation having a wavelength of less than about 200 nm.

23. The method of claim 22 wherein the photoresist layer is exposed to radiation having a wavelength of less than 170 nm.

30 24. The method of claim 22 wherein the photoresist layer is exposed to radiation having a wavelength of about 193 nm.

25. The method of claim 22 wherein the photoresist layer is exposed to radiation having a wavelength of about 157 nm.

5 26. The method of any one of claims 22 through 25 wherein the underlayer composition is thermally treated prior to applying the photoresist composition.

27. The method of any one of claims 22 through 26 wherein the underlayer composition is crosslinked prior to applying the photoresist composition.

10 28. The method of any one of claims 22 through 27 wherein the underlayer composition comprises an integral component that comprises both i) aromatic and/or alicyclic groups and ii) chromophore groups.

15 29. The method of any one of claims 22 through 27 wherein the underlayer composition comprises a first component that comprises aromatic and/or alicyclic groups and a second component distinct from the first component that comprises chromophore groups.

20 30. The method of any one of claims 22 through 29 wherein the chromophore groups comprise anthracene groups.

31. The method of any one of claims 22 through 30 wherein the underlayer composition component that comprises aromatic and/or alicyclic groups comprises optionally substituted phenyl groups, optionally substituted naphthyl groups, optionally substituted adamantyl groups, optionally substituted norbornyl groups, or optionally substituted isobornyl groups.

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32. The method of any one of claims 22 through 31 wherein the underlayer composition comprises a mixture of at least two distinct resins.

33. The method of claim 32 wherein one resin of the underlayer composition comprises aromatic and/or alicyclic groups and a second resin of the underlayer composition comprises one or more chromophore groups.

5 34. The method of any one of claims 22 through 33 wherein the underlayer composition comprises i) a first resin that comprises units that comprises phenyl groups and ii) a second resin that comprises units that comprise anthracene groups.

10 35. The method of any one of claims 22 through 34 wherein the underlayer composition comprises a phenolic resin.

36. The method of any one of claims 22 through 35 wherein the underlayer composition comprises a novolak or poly(vinylphenol) resin.

15 37. The method of any one of claims 22 through 36 wherein the underlayer composition comprises an acrylate resin.

38. The method of any one of claims 22 through 37 wherein the underlayer composition comprises an acrylate resin that comprises anthracene moieties.

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39. The method of any one of claims 22 through 38 wherein the underlayer composition comprises an acid or acid generator compound.

40. The method of any one of claims 22 through 39 wherein the underlayer
25 composition comprises a thermal acid generator compound.

41. The method of any one of claims 22 through 40 wherein the underlayer composition is not photoimageable.

30 42. The method of any one of claims 22 through 41 wherein the underlayer composition comprises a crosslinker component.

43. The method of any one of claims 22 through 42 wherein the underlayer composition is crosslinked.

5 44. The method of any one of claims 22 through 43 wherein a photoresist composition comprises a resin with Si groups.

45. The method of any one of claims 22 through 44 wherein a photoresist composition resin comprises phenolic groups.

10 46. The method of any one of claims 22 through 45 wherein a photoresist composition resin comprises photoacid-labile groups.

15 47. The method of any one of claims 22 through 46 wherein the photoresist composition is imaged with activating radiation and the imaged photoresist composition is treated with a developer to provide a photoresist relief image.

48. The method of claim 47 wherein areas bared of photoresist upon treatment with a developer are etched.

20 49. The method of claim 48 wherein areas bared of photoresist upon treatment with the developer are exposed to a plasma gas.

50. The method of claim 49 wherein the plasma gas penetrates the underlayer composition.

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51. The method of any one of claims 22 through 50 wherein the substrate is a microelectronic wafer.

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52. An article of manufacture comprising a substrate having coated thereon a multilayer photoresist system,

the system comprising:

5 a) an organic underlayer composition coating layer on a substrate, the underlayer composition comprising a component that comprises aromatic and/or alicyclic groups and a component that comprises one or more chromophore groups;

b) over the underlayer composition coating layer, a photoresist composition coating layer for short wavelength imaging, the photoresist comprising a photoactive component and an Si-containing component.

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53. The article of claim 52 wherein the substrate is a microelectronic wafer substrate, an optoelectronic device substrate or a waveguide.

54. An underlayer composition for use with an overcoated silicon-containing photoresist imaged at under 200 nmt, the underlayer composition comprising:

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a first resin that comprises phenolic groups, and a second resin that comprises anthracene groups.

55. The underlayer composition of claim 54 wherein the first resin is a novolak resin or a poly(vinylphenol) resin.

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56. The underlayer composition of claim 54 or 55 wherein the second resin comprises acrylate groups.

57. The underlayer composition of any one of claims 54 through 56 further comprising a crosslinker component.

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58. The underlayer composition of any one of claims 54 through 57 further comprising an acid or an acid generator compound.

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59. The underlayer composition of any one of claims 54 through 58 wherein the composition comprises a thermal acid generator compound.

60. The underlayer composition of any one of claims 54 through 59 wherein the composition is not photoimageable.